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# THE GOLDEN JUBILEE OF THE FRENCH ASTRONOMICAL SOCIETY

By C. A. CHANT

THE fiftieth anniversary of La Société Astronomique de France was celebrated on June 16, 1937, although at that date (it was remarked) its age was 50 y. 4 m. 19 d. For various reasons an account of this notable occasion in this JOURNAL has been delayed until the Society is 51 y. 8 m. old.

In 1879 Camille Flammarion published his *L'Astronomie Populaire* of which, ten years later, the 100th edition was issued. The remarkable reception accorded this volume showed that the ordinary intelligent person was interested in the heavens above him and, further, enjoyed the poetry and philosophy plentifully distributed by its author throughout his descriptions of cosmic phenomena. In 1882 an admirer presented Flammarion with an estate and château at Juvisy, near Paris, and here he installed and equipped a private observatory to which he added later a meteorological and climatological station. In this same year he established a magazine entitled *L'Astronomie* which was intended to lead his readers and correspondents to retain their interest in astronomy and related subjects. This also was a decided success and circulated in all parts of the world.

Flammarion felt, however, that something further was needed, namely, a society "to form a bond between isolated observers, to centralize their labours and to encourage them to persevere in a way so useful to progress". Beginning in 1858, at the age of sixteen,

Flammarion spent many years in the Paris Observatory, chiefly in the astronomy of position, but this precise work of measurement, although indispensable to astronomy, could not prevent his flaming imagination from soaring out into space to explore the nature and condition of the planets and also those bodies infinitely beyond our solar system. He invited some of his friends to meet in his apartment on January 28, 1887, to study means to promote in France the taste for astronomy. He communicated his ideas to Admiral Mouchez, the director of the Paris Observatory, who at this time was busy making arrangements for the first international Congress of the Carte du Ciel, which met in Paris in April 1887. Under date February 12, 1887, Mouchez, in a letter to Flammarion discussing the Congress remarked:

> I understand that you wish to found an Astronomical Society in Paris. You will not find the elements for it. No person in France beyond "officialdom" and Flammarion spends a cent for an instrument and does anything for astronomy. We are not in England. *I endeavoured to found such a Society* when I came to the Bureau des Longitudes. I quickly realized that we lack completely the necessary elements and that one would find only humbugs—if indeed one would find them! There is nothing, I believe, to found in Paris in this manner.

This pessimistic forecast did not deter Flammarion from proceeding with his work of organization and although the Société Astronomique de France attained immediate success, this did not lead the Admiral to withdraw his continued opposition to its work and its workers. Indeed one is tempted to compare its value to the world of science and culture with that of Mouchez' still unfinished grandiose scheme of photographing the entire sky in the manner decided upon at his congress. Perhaps the meeting together of astronomers from widely separated nations was the most valuable part of the whole project.

At the end of the first year the Society had 155 members, some of them being eminent representatives of professional and amateur astronomy in different countries. One recognizes, of course, the inspirational leadership of Flammarion (Fig. 1) in the movement. A multitude of people were attracted to him and followed his guidance much as the planets, large and small, are held in their courses as they revolve about the sun. But the disciples of the founder

Figure 1.—Camille Flammarion, founder of the French Astronomical Society.

absorbed his spirit and the organization was so perfected and strengthened that it still continued after the "master" was gone.

The first twelve meetings of the Society, from January 28, 1887, to March 7, 1888, were held in Flammarion's apartments on the fifth floor (without an elevator) at No. 16, Rue Cassini, but the growing astronomical family soon required larger quarters. Fortunately an old and famous mansion was on the market and it was acquired by a group of about twenty learned societies. It became L'Hôtel des Sociétés Savantes and is still the Society's headquarters (Fig. 2).

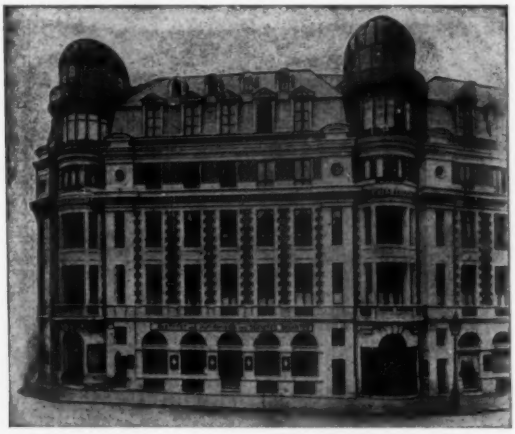


Figure 2.—L'Hôtel des Sociétés Savantes, headquarters of the French Astronomical Society.

The Society obtained, chiefly as gifts, some modest astronomical instruments, and a number of enthusiastic young men eagerly used them. Some of these persons in after life became well-known French astronomers, seldom losing active interest in the Society and its beneficent aims. The monthly journal *L'Astronomie* became the organ of the Society and although it encountered difficult conditions during the world war it is still carrying forward its useful work in a vigorous way.

Flammarion was president for two years, 1887-89, and his suc-

cessors have been outstanding leaders in French science. The list is as follows, each occupying the position for two years: Faye, Bouquet de la Grye, Tisserand, Janssen, Cornu, Callandreau, H. Poincaré, Lippmann, Caspari, Deslandres, B. Baillaud, P. Puiseaux, de la Baume Pluvinel, Appell, Prince Roland Bonaparte, Lallemand, Ferrié, Fichot, General Perrier, Ch. Fabry, Esclangon, Jules Baillaud, and for 1937-39, Ch. Maurian.

The other officers—secretary, treasurer, librarian, and their assist-

Figure 3.—Professor and Madame Camille Flammarion, 1925.

ants, as well as the editing committee—have been notable for their ability and their devotion to their duties, and some of them have held their positions for many years. The present gracious and capable General Secretary is Madame Gabrielle Camille Flammarion, who has occupied that important position since 1925, the date of the death of her illustrious husband (Fig. 3).

The celebration of the semi-centenary on June 16, 1937, was held in the large amphitheatre of the Sorbonne in the presence of a

distinguished audience. In the front row sat M. Albert Lebrun, President of the French Republic, on his right were Madame Flammarion and General Perrier, on his left was Professor Jean Perrin. Addresses were given by Professor Perrin who replaced M. Jean Zay, Minister of National Education, prevented from attending at

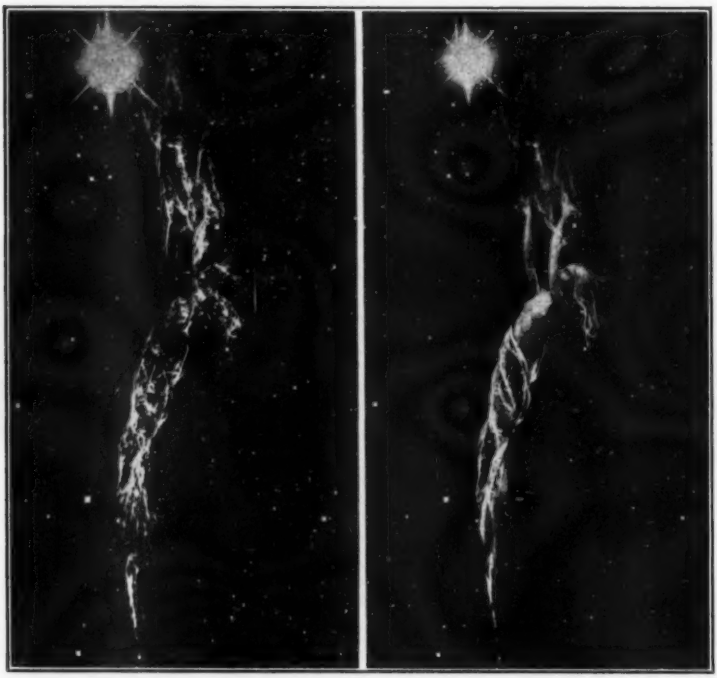


Figure 4.—An illustration from the program of the semi-centenary celebration of the Astronomical Society of France. The nebula represented is N.G.C. 6960, in Cygnus.

the last moment through a "ministerial crisis"; M. Jules Baillaud, who spoke on "La Société Astronomique de France" and gave the names of some forty societies, schools and institutes throughout the world which had personal representatives at the meeting, and men-

tioned many other messages of congratulation which had been sent in and are printed in *L'Astronomie* for November 1937; and by Professor Ch. Fabry, on "A Half-century of Astronomy" (with lantern illustrations). Then followed a film entitled "Camille Flammarion and the French Astronomical Society"; and a Concert which included, among others, musical numbers entitled, The Wind, Evening, Shooting Stars, Dear Night, etc. The meeting dissolved about midnight.

On the next day, June 17, at the Pavillon d'Armenonville in the Bois de Boulogne the reception committee of the Paris International Exposition offered to the distinguished visitors who had come to France to take part in the semi-centennial celebration and to the members of the office of the Society a dinner in which both "astronomy and gastronomy were honoured."

A few words may appropriately be added here regarding our Canadian Society. After some years of informal discussions among a number of lovers of science living in Toronto, the Astronomical and Physical Society of Toronto was organized, the first meeting under its new Constitution and By-laws being held on February 25, 1890. Later in that year it was incorporated under the laws of Ontario. At first the meetings were held at the homes of members, much as in the case of the French Society. In 1900 it assumed the name, the Toronto Astronomical Society, and in 1903, with formal permission, it became the Royal Astronomical Society of Canada. The present writer became a member of the Society on December 13, 1892. The founders of the Society were his personal friends, and he can record that the leaders in the movement were distinctly influenced by the French Society. The enthusiasm of Flammarion had spread across the Atlantic to them and they endeavoured to emulate in Canada his fruitful labours in France.

The thanks of this JOURNAL are due to the French Astronomical Society for the loan of blocks for the first three illustrations in this article.

David Dunlap Observatory,
Richmond Hill, Ont.

# NOTE ON THE ORBIT OF BOSS 3511

By W. E. Harper

In 1918 a preliminary orbit of this spectroscopic binary, which was discovered at the Lick Observatory, was published by the author from Ottawa using 32 plates made in 1917 and 6 in 1918. After coming to Victoria the star was kept under observation as the residuals from the curve determined at Ottawa were larger than should be for a beautiful sharp-lined star such as this one.

A large number of spectra have been accumulated in the intervening years, the observations being continued from year to year through a feeling that the radial velocity curve seemed to undergo changes. While alternative periods to the one of 1.611 days used at Ottawa were considered, this seemed the best at the time. Later one of the other periods, namely 2.613, was accepted. Numerous solutions were put through using observations of the various years separately without any success in showing definite changes of the form of the curve. Eventually the constancy of the elements was accepted with a value of the period of 2.61314 days. This satisfied the 140-odd observations made at Victoria, the 4 early Lick ones and the 38 made at Ottawa, although the latter are a little ragged.

Some little work remains to be done in determining systematic differences between the various series of observations and then the full paper will appear as a number of the Victoria Publications.

# THE SMALL OBSERVATORY AND ITS DESIGN

By H. Boyd Brydon

(*Concluded from May-June number*)

## IV

### Observatories for Stationary Eyepiece Mountings

When a stationary eyepiece mounting is used, modifications are desirable in some of the dimensions of the observatory because of the changed proportions of the telescope and in the counterbalancing required, particularly in declination.

A telescope will be in balance in declination when the sum of the products of the weights of all the parts on one side of the declination axis each multiplied by its distance therefrom is equal to the corresponding total for the parts on the opposite side of that axis; or more precisely, when the moments about the declination axis are equal. Neglecting the weight of the tube, if $M$ be the weight of the mirror and its cell and $C$ the counterpoise used to balance $M$; $L$ and $D$ the distances of their respective centres of gravity from the declination axis, the telescope will be balanced in declination when $C \times D = M \times L$, or, as $M \times L$ is constant, the greater the counterpoise the less must be its distance. But as the telescope must be balanced in right ascension also,[10] increasing the counterpoise in declination involves a proportional increase in the counterpoise in right ascension or its distance from the polar axis, which increases the bending moment in the declination axis.

Among the conditions assumed above for designing the observatory, the distance of the eyepiece or diagonal mirror from the lower end of the telescope was given as $7D$.

It will be somewhat less in a stationary eyepiece mounting, say $6D$, which happens to be the length of the tube above the declination axis as given for the "standard" telescope on page 234 above. If the

[10]It will be found preferable to use separate weights to obtain balance, one for right ascension, the other for declination, instead of the single weight often seen which is intended as the resultant of these two.

length of this part of the tube be kept equal to $6D$ in the stationary eyepiece mounting, the lengths above and below the declination axis will be equal and the counterpoise required in declination will be about equal to the weight of the mirror and its cell, some 30 lb. for a 12-inch.[11] If the counterpoise be brought nearer to the declination axis, say to $4D$, the weight required will be increased to about 45 lb., which increases the bending moment in the tube as well as in the declination axis but is not excessive for a 12-inch telescope.[12]

The approximate overall dimensions of a telescope having a stationary eyepiece mounting may now be compared with those of a "standard" telescope. These figures are given for a 12-inch telescope in the accompanying Table III.

TABLE III—PROPORTIONS OF 12-INCH TELESCOPES

| Type of Mounting | "Standard" | | Stationary eyepiece | |
|---|---|---|---|---|
| | ft. | in. | ft. | in. |
| Length of tube from | | | | |
| Back of cell to dec. axis | 2 | 6 | 6 | 0 |
| Dec. axis to upper end | 6 | 0 | 4 | 0 |
| Overall | 8 | 6 | 10 | 0 |
| Distance from | | | | |
| Back of cell to floor (say) | 1 | 6 | 1 | 6 |
| Floor to intersection of axes | 5 | 6 | 7 | 6 |
| Floor to eyepiece, minimum | 7 | 0 | 8 | 0 |
| Floor to eyepiece, maximum | 10 | 0 | 8 | 0 |

It is clear from these figures that an observatory designed to house a "standard" telescope will not have the most suitable proportions for a stationary eyepiece telescope. For instance, it is impracticable to provide gangway space at the low end of the instrument, nor is it necessary, as there is full headroom everywhere else. The rectangular part of the observatory, therefore, can be made correspondingly smaller than for the "standard" telescope. Also the shorter upper part of the tube permits of a simple dome roof.

[11]The exact weight will depend upon a number of minor details, among which is the construction of the tube itself.

[12]As cast iron weighs about 0.26 lb. per cu. inch the counterpoise may be conveniently a ring say 14 inches inside and 16½ inches outside diameter by about 3½ inches long, which will weigh about 50 lbs., permitting some adjustment in position along the tube.

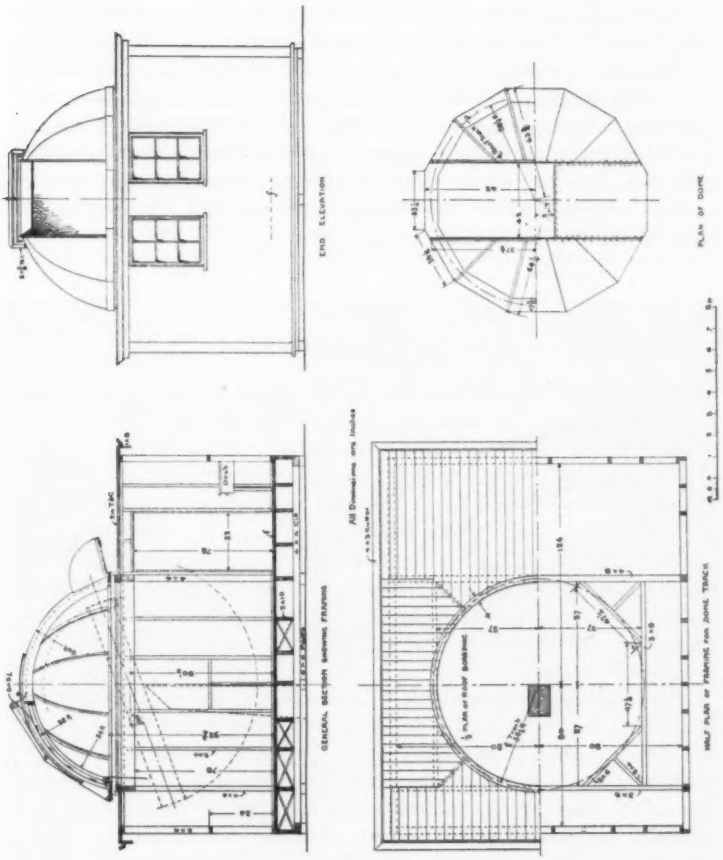

END ELEVATION
PLAN OF DOME
GENERAL SECTION SHOWING FRAMING
All Dimensions are Inches
PLAN OF ROOF BOARDING
HALF PLAN OF FRAMING FOR ZINC TRACK

Fig. 21.—Observatory for 12-in. Telescope having Stationary Eyepiece Mounting.

These considerations are incorporated in the design in Fig. 21 for an observatory to house a 12-inch stationary eyepiece telescope.

By comparing this design with that in Figs. 14 and 16 for the "standard" instrument, it is seen that an observatory for a stationary eyepiece telescope should cost appreciably less, which opens an interesting question, for if this difference in cost be applied to the purchase of better quality prisms for the two diagonals, a major objection to the stationary eyepiece type of mounting, namely, poor definition, may be reduced to an extent which would entitle it to the serious consideration of the amateur as compared with the usual form of Newtonian or Cassegrainian.[13]

## V

### Housetop Observatories

For various reasons it is sometimes necessary or desirable for the small observatory to be a part of the owner's dwelling instead of a separate building. Examples received incidental reference in a previous paper in this Journal*; short, illustrated descriptions frequently have appeared in Popular Astronomy and elsewhere.

Such observatories afford much scope during their planning and construction for ingenuity in overcoming the many difficulties which arise and occasionally result in curious if inevitable makeshifts. In one case, for example, entrance to the observatory was gained by climbing up a disused chimney, a sort of Santa Claus progress in reverse.

As it is usually impossible to extend the pier to the ground, free from contact with the building, some way must be found to avoid transference to the telescope of the incessant vibration of the house and the observatory floor, always a serious problem in these cases. An idea can be obtained of the amount and direction of the vibration by watching the ripples on water placed in a shallow square pan and set on a table or on the floor of the room. Artificial light serves best for this experiment.

---

[13]Some information on the relative costs of prisms appears in the appendix.

*Brydon, "Telescope Mountings for Amateur Builders," this Journal, XXI, 1937, pp. 4, 7.

Transference of vibration to an object from its supporting structure or the reverse can be reduced in two ways: (1) by setting the object on a non-rigid substance such as sand, felt, cork, leather, sheet lead, etc.; (2) by changing the mass of the object or its immediate support so as to make its natural period of vibration longer and thus prevent resonance. For instance, where a machine on an upper floor causes objectionable vibration to occur elsewhere in the building it is frequently possible to abate the nuisance by bolting some additional mass to the machine or by securing a block of heavy material to the ceiling immediately underneath it.

Irregular air currents caused by wind eddies or radiation from the walls and roof of the house or by the transmission of heat or

Fig. 22.—Bliss Housetop Observatory. I am indebted to the Editor of Popular Astronomy for this illustration. It appeared in a detailed description of his observatory by Mr. O. J. Bliss, "An Amateur's Housetop Observatory," Pop. Ast., vol. XLIV, p. 412.

heated air through the floor and walls of the observing room sometimes seriously affect the usefulness of these observatories. All that can be done is to keep the point in mind when selecting the position of the telescope but the direction of the winds prevailing *during the best observing season* should be carefully considered so that smoke and heated gases from the owner's or his neighbour's chimneys may interfere as little as possible with the seeing.

A telescope supported from the floor of an upper room is continually jarred and tilted by the vibration and varying deflection of the floor as one or more persons move about on it. Fig. 22 shows an observatory in which this difficulty was avoided by setting the mounting not on a pier from the floor but on a box

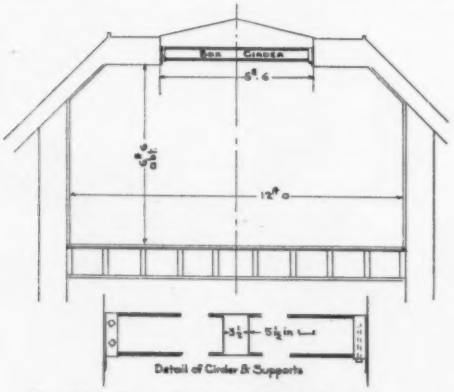



Fig. 23.—Cross Section of Bliss Observatory.

girder extending from the north to the south sides of the 5½ foot square roof opening. By this simple construction tilting is eliminated and vibration very greatly reduced and, as ample head-room is provided beneath the girder, much valuable floor space is made available.

The ends of the girder are bolted to U-shaped hangers secured to the walls. At one end the bolts are vertical and at the other horizontal, affording adjustment of the girder in altitude and azimuth, not only during erection but as the expansion, contraction and settlement of the house may render necessary in the future,

a wise provision. Fig. 23 is a general section approximately to scale through the observatory on a north and south line. The roof is of the run-off type on ball-bearing rollers.

It should be noted that this observatory which has proved very satisfactory in use was part of the original design of the house and was built with it, 12-in. brick walls being carried up to the observatory.

In his letter according me permission to describe his observatory Mr. Bliss stresses the thorough study the problem received. He says: "In developing the design the building members were considered a part of the telescope mounting from the concrete footings, foundation, brick walls and roof members to the telescope tube. The mounting is rigid and as free from vibration as could be expected. However, seeing conditions are affected at times by radiation from the roofs."

The plan developed by Mr. Bliss should prove even more valuable when adapting part of an already built frame house as an observatory for greater vibration must be combatted. By using heavy cork or felt pads, say 1-in. thick between the walls and the girder supports and between these supports and the girder and resting the mounting on strips of sheet lead (two strips superimposed with felt or leather between them are better than one strip of equivalent thickness) vibration of the telescope should be reduced to a bearable amount. It may be found beneficial to fill the box girder with sand or a mixture of plaster and sawdust or to load certain points in its length. Some improvement will result from covering the observatory floor with felt overlaid with carpet or linoleum. If a choice of rooms is possible it is likely that less vibration will be transmitted to the girder supports if the floor joists run east and west instead of north and south. The problem is distinctly one in which experiment is indicated. The water test described above will be a help here. The result of each test should be clearly noted in writing when it is made.

## VI

### An Observing Stand

Too often in the small observatory the observing stand is a packing case or the household step-ladder. The stand shown in Fig. 24 was designed for use with a "standard" 12-inch Newtonian but can be modified easily to suit other instruments. Fitted to the handrail of the platform is a chart table having a raised edge and

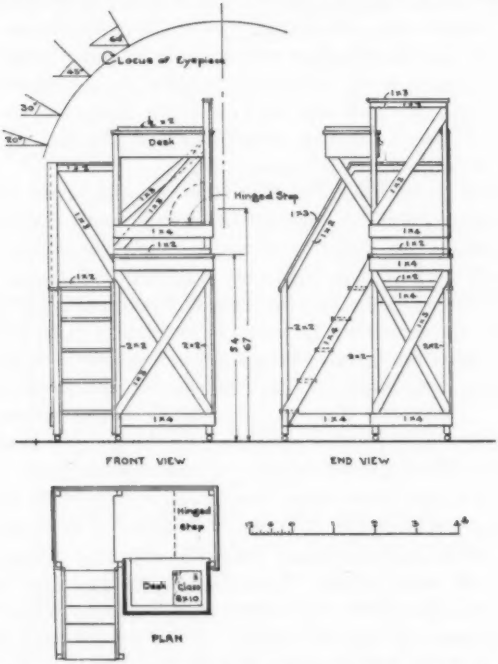



Fig. 24.—Observing Stand for 12-in. Newtonian Reflector.

a hinged ground glass top which may be lighted from above or below from a circuit plugged into a receptacle on the pier. A drawer with spaces for eyepieces, star diagonal, solar diagonal, etc., and for charts and note books is fitted under the table. Details may be

altered to suit individual requirements but such a stand will be found simple to build and safe and convenient to use.

My thanks are due for valuable help in the preparation of this paper to Messrs. O. J. Bliss, H. Hodgkinson and E. H. Morse for permission to incorporate descriptions of their designs and for photographs and drawings of their observatories; to the Editor of Popular Astronomy, Dr. C. H. Gingrich for permission to refer to the article on "House-top" observatories and for the use of Fig. 22; to Mr. Edward Simpson for generous advice and suggestion in the design of many details and to Mr. Robert Peters who most kindly read the proof and checked many of the calculations involved in the designs presented.

## APPENDIX

### Strength of Wooden Beams

The curves given below afford means of determining the distributed quiescent loads that can be safely carried per foot of span by sound pine beams 1 inch wide and of the depth shown (actual, not nominal dimensions). Thus on a span of 10 feet a beam 1 in. wide and 8 in. deep will carry a total quiescent load distributed evenly along it of $154 \times 10 = 1540$ lb., including its own weight; 2 in. wide, 3080 lb.,

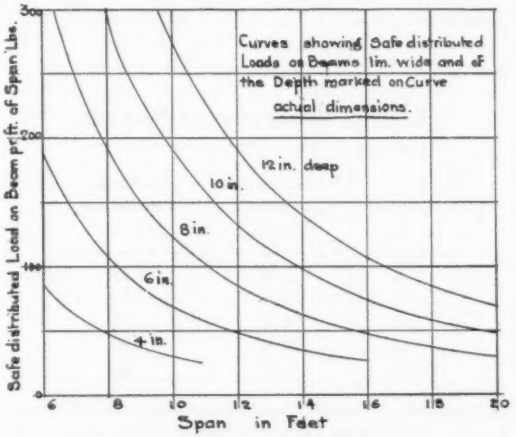



Fig. 25.—Strength of Wooden Beams.

etc. When the load is concentrated in the centre of the span the safe quiescent load is one-half that shown by the curves.

Snow Loads. Trantwine states that snow moistened and compacted by rain will weigh from 15 lb. to 50 lb. per cu. ft.

The Table of Regular Polygons below will be found convenient when designing polygonal members such as wall plates, roofs, etc.

TABLE OF REGULAR POLYGONS

| No. of sides | Radius of Circumscribed Circle | | Length of side Radius of | | Radius of inscribed Circle Side = 1 |
|---|---|---|---|---|---|
| | Perpendicular from centre = 1 | Side = 1 | Circumscribed Circle = 1 | Inscribed Circle = 1 | |
| 8 | 1.0824 | 1.307 | 0.7654 | 0.8284 | 1.207 |
| 10 | 1.0515 | 1.618 | .6180 | 0.6498 | 1.539 |
| 12 | 1.0353 | 1.932 | .5176 | .5359 | 1.866 |
| 14 | 1.0257 | 2.247 | .4451 | .4565 | 2.190 |
| 16 | 1.0196 | 2.563 | .3902 | .3978 | 2.513 |
| 18 | 1.0154 | 2.879 | .3473 | .3527 | 2.835 |
| 20 | 1.0125 | 3.196 | .3129 | .3168 | 3.156 |

RELATIVE PERFORMANCE OF TELESCOPES

| Aperture in. | Minimum Magnitude Visible | Limit of Resolution sec. arc |
|---|---|---|
| 6 | 13.9 | 0.78 |
| 8 | 13.5 | .60 |
| 10 | 14.0 | .47 |
| 12 | 14.4 | .40 |
| 14 | 14.8 | .32 |

Actual performance is affected by many factors and may differ materially from the above figures. For a most useful discussion of this subject see Louis Bell, "The Telescope", Chap. XI, "Magnification and Seeing".

PRISMS—APPROXIMATE LIST PRICES OF RIGHT-ANGLED PRISMS

| Diam. of Base surface in. | Price | |
|---|---|---|
| | A | B |
| 1.0 | $13.50 | $5.00 |
| 1.25 | 16.50 | 8.50 |
| 1.50 | 27.50 | 10.00 |
| 1.75 | 30.00 | 12.50 |

"*Quality A* is used for process photography. The greatest error over the surface does not exceed 1/50,000 in. and the angle is correct to 30″. *Quality B.* These prisms are of reasonable accuracy and are suitable for ordinary experimental purposes. Prisms having surfaces flat to 1/1,000,000 in. and angles correct to 5″ can be supplied to order."

SIZES OF LUMBER

As the actual sizes of dressed lumber are less than the nominal sizes, the following table may be of value when designing.

| Nominal Size | | Approximate actual size | |
|---|---|---|---|
| Thickness | Width | Thickness | Width |
| ¼ | 2, 3, 4 | ¼ | 1¼, 2¼, 3¼, etc. |
| 1 | 2, 3, 4, 6, 8, etc. | ⅞ to ¾ | 1¼, 2¼, 3¼, etc. |
| 2 | 2, 3, 4, 6, 8, etc. | 1½ | 1¼, 2¼, 3¼, etc. |
| 3 | 6 | 2½ | 5¼ |
| 4 | 4 | 3½ | 3½ |
| 4 | 6 | 3½ | 5¼ |

2390 Oak Bay Avenue,
Victoria, B.C.

# SPRING MEETING OF THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS

By D. W. Rosebrugh

THE Twenty-seventh Spring Meeting of the A.A.V.S.O. was held at Ladd Observatory on May 27 and 28 through the kind invitation of Dr. Charles H. Smiley, newly appointed head of the Department of Astronomy, Brown University, Providence, R.I.

Some fifty members were present at each session but we missed our Canadian members who attended the 1937 Spring Meeting. It is hoped, however, to make the acquaintance of many Canadian amateur and professional astronomers within the next year or two when it is anticipated that the A.A.V.S.O. will hold its spring meeting in Toronto.

On Friday evening the Rhode Island Skyscrapers acted as host to the A.A.V.S.O. at a lecture on "Comets" by Dr. Carl Stearns, Van Vleck Observatory, Wesleyan University, Middletown, Conn. Dr. Stearns stated that the orbits of about 500 comets have been computed. Because it is easiest to compute a parabolic orbit 75% of these are listed as travelling in parabolas, which closely resemble ellipses in the small portion of the orbits lying near the earth and sun, but it is now believed that almost all comets travel in ellipses and belong to the solar system. Dr. N. T. Bobrovnikoff, among others, believes that the sun's comet family may have been captured by the sun about a million years ago.

Scientific papers were given at the Saturday morning session. Dr. Harlow Shapley, Past-President of the A.A.V.S.O. and Director of the Harvard College Observatory, gave an illustrated lecture on "Variable Stars and the Thickness of the Milky Way". A cluster type variable star with a period of 24 hours or less is the best measuring rod for galactic distances as it is known that the mean brightness of such a star is about absolute magnitude zero. Twenty-three hundred cluster type cepheids are now known, 500 of which are located in globular clusters and the rest in the Milky Way at large. As a result of studies of the distances of cluster type variable stars through various "windows" which have been located through the

star clouds of the galaxy it is believed that the Milky Way is a discoid 35,000 parsecs in diameter and 300 parsecs thick. Surrounding this flattened discoid is a globular halo about 40,000 parsecs in diameter the density of which falls to about 1/10,000 of that in the galactic plane at a distance of 12,500 parsecs from the galactic plane.

In the early afternoon Dr. J. B. Focke of the Physics Department aluminized a mirror for the edification of the members. The contrast between the precision of this process and the unreliability of the silvering process as practised by amateurs was very striking.

The instrumental equipment at the Ladd Observatory was then inspected including the 12″ Brashear refractor, solar spectroscope, time clocks and the 6″ F 1 Schmidt camera with which Dr. Smiley photographed the corona and Zodiacal Light at the 1937 eclipse in Peru.

The Skyscrapers then led a motorcade to the Seagrave Memorial Observatory, North Scituate, R.I. This cylindrical type of observatory houses an 8″ Clark refractor which it is hoped that the members of the Skyscrapers will put to good use in observing faint variable stars.

Mr. Charles W. Elmer, President of the A.A.V.S.O., appointed Dr. Alice Farnsworth, Mt. Holyoke College, as toastmistress of the evening banquet, which was held at the Hearthstone in East Providence. Dr. Annie Cannon talked very entertainingly of amusing incidents at former meetings of the A.A.V.S.O.

Mr. Leon Campbell, Recorder, A.A.V.S.O., and Pickering Memorial Astronomer of Harvard College Observatory, described "The A.A.V.S.O. and its Problems". He stated that Harvard College Observatory had commenced a photographic survey and study of all variable stars brighter than 11.0 magnitude. When the photographic light curves are compared with the visual curves as obtained by the A.A.V.S.O. it is anticipated that fresh information about variable stars will become available. By some spectroscopic work and by group discussions among professional astronomers it is hoped to learn the causes of such phenomena as "still stands" and other peculiarities in the curves of long period variable stars. Among other work undertaken by the A.A.V.S.O. and results achieved, Mr. Campbell listed lunar occultations, the systematic nova search,

work on asteroids and tentative classifications of long period variables and novae.

Dr. Shapley introduced Dr. Cecilia Payne Gaposchkin, who stated that the Harvard plates would be studied for 50 years past, that some 2,000 variable stars would be thoroughly reviewed, and that it is anticipated that many new variable stars will be found such as the eclipsing star –32 degrees 15317 described by Dr. Sergei Gaposchkin at the morning session.

Dr. and Mrs. Shapley extended their customary cordial invitation to the A.A.V.S.O. to meet at Harvard on October 15 for the Twenty-seventh Annual Meeting.

Poughkeepsie,
New York.

# THE OTTAWA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

By Peter M. Millman

(With Plate VIII)

IT is not often that Canada has the honour of entertaining the American Association for the Advancement of Science, an association which serves as a common meeting ground for all the sciences and which makes possible that co-operation between widely diversified fields which is becoming more important every year. This spring Ottawa, for the first time, played host to the visiting scientists from all over the continent, and superb weather combined with an efficiently planned programme made the meetings very enjoyable.

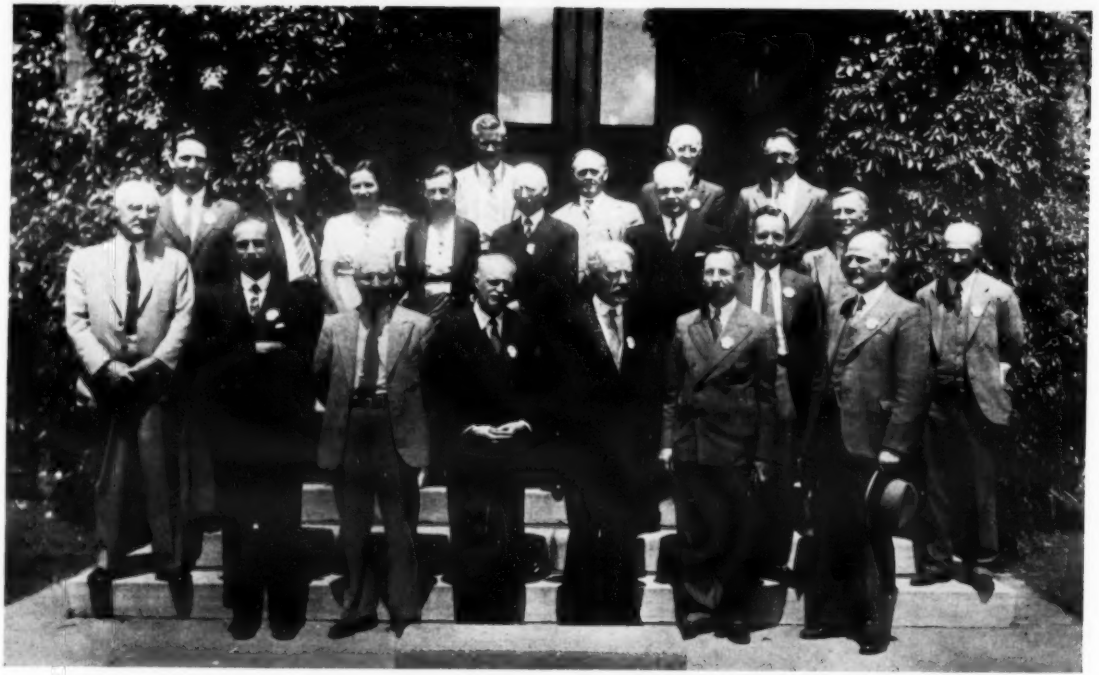
The sessions for papers commenced on Monday, June 27, and, except for field trips, were completed on Thursday, June 30. The total atendance was 1,104 registered members of the Association and affiliated societies, in addition to about 400 non-registering guests made up of the families of the members. This was one of the largest spring meetings in the history of the Association and it was certainly one of the most successful. Canadian scientists were well represented, accounting for 755 of the registered members and presenting approximately two thirds out of a total of 466 papers given in the various sections.

Section D, on Astronomy, held joint sessions with the Royal Astronomical Society of Canada under the chairmanship of Mr. R. Meldrum Stewart, the Dominion Astronomer. Tuesday and Wednesday mornings the astronomers gathered at the Dominion Observatory for a programme of 26 papers in all. A large majority of these papers were presented by members of the staffs of Canadian observatories, but covered a wide range of subjects as may be seen by a perusal of the accompanying programme. Space forbids any attempt at a discussion of the individual papers, but let it suffice to say that each seemed to have its own peculiar interest and value. Thursday morning a symposium on atmospheric ozone was held at the Masonic Temple and in four excellent papers we were given a general survey of the field both from a theoretical and observational standpoint. In particular it was pointed out how the astronomer

could assist the physicist in gathering observational data on this important phase of the study of the upper atmosphere. A photograph of the members of Section D was taken after the Wednesday morning session and it is to be regretted that many of those present for the papers were unable to remain for the picture. The total attendance in Section D was well over twice that indicated by the camera lens.

An enjoyable series of evening lectures was given for the Association as a whole by noted authorities in the various scientific fields. These lectures dealt with the future of the sciences. The outstanding address of the Ottawa meetings was the Hector Maiben Lecture given on Wednesday evening, June 29, by Principal R. C. Wallace of Queen's University, on the subject "The Changing Values of Science". With rare skill the speaker showed how the purely mechanistic ideal in science, which reached its peak at the close of the last century, had gradually been forced to give way before the dawning realization that there was something more than strict causality in the universe of time and space and in the relation of man to this universe. The concepts of Eddington, Whitehead, and Dingle were contrasted as examples of modern philosophic thought on this subject by men who were "scientists first and philosophers second".

Apart from the special lectures and sessions for papers there were a number of interesting features planned by the entertainment committee. A garden party was held at the experimental farm on Tuesday afternoon at which upwards of 1,500 guests were present and an opportunity was given to inspect the beautiful sunken garden, a memorial to the founder of the farm. Arrangements were also made for members of the Association to visit the House of Commons, the Royal Mint, and other points of interest in Ottawa, and Thursday afternoon there was a two-hour drive around the city, across the Ottawa river, and through the neighbouring towns in Quebec. It was only then that gathering rain clouds drew the curtain on a programme which could not but fail to emphasize the hospitality of Canada's capital city. I am sure I echo the thoughts of all visitors at the meetings when I express our thanks to the local committee and in particular to the Dominion Astronomer who, as Vice-President



OTTAWA MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

*Front Row*—J. P. Henderson, Ottawa; D. B. Nugent, Ottawa; J. Pauling, Washington, D.C.; R. M. Stewart, Ottawa; H. T. Stetson, Cambridge, Mass.; W. E. Harper, Victoria.
*Extreme left*—G. H. Ling, Saskatoon; *extreme right*—R. J. McDiarmid, Ottawa.
*Second Row*—J. B. Irwin, Washington, D.C.; C. Reinhardt, Perth, Ontario; Miss R. Northcott, Toronto; Miss M. S. Burland, Ottawa; J. R. Collins, Toronto; L. J. O'Connor, Ottawa; P. M. Millman, Toronto; W. E. W. Jackson, Ottawa.
*Back Row*—W. S. McClenahan, Ottawa; R. E. DeLury, Ottawa; C. A. French, Ottawa; E. C. Arbogast, Ottawa.

of the A.A.A.S., was responsible for planning and organizing the astronomical sessions, and to Professor Harlan Stetson, Secretary of the Section.

PROGRAMME OF SECTION D

Tuesday Morning Session, Joint Session with Royal Astronomical Society of Canada, June 28, 10.00 a.m.; Dominion Observatory, Carling Ave.

1. Fifty Years of Astronomical Work in Canada. W. E. Harper, Dominion Astrophysical Observatory, Victoria.

2. The Radial Velocities of 480 Stars in and near the Kapteyn Areas North of the Equator Observed at the David Dunlap Observatory. R. K. Young, David Dunlap Observatory, Richmond Hill.

3. The Absolute Magnitudes and Parallaxes of Approximately One Thousand Stars of Class A. W. E. Harper, Dominion Astrophysical Observatory, Victoria.

4. The Solar Motion with Respect to Distance from the Galactic Plane as Determined from Class A Stars. W. E. Harper, Dominion Astrophysical Observatory, Victoria.

5. Solar Rotation Measurements at Ottawa. Ralph E. DeLury and John L. O'Connor, Dominion Observatory, Ottawa.

6. Present State of Solar Activity and Related Phenomena. Harlan T. Stetson, Massachusetts Institute of Technology, Cambridge, Mass.

7. Agincourt Magnetic Data, 1899 to 1937, and the Sunspot Cycle. W. E. W. Jackson, Dominion Observatory, Ottawa.

8. Regional Types of Sunspot Influence on Tree-Growth in Canada. John L. O'Connor, Dominion Observatory, Ottawa.

9. Some Canadian Economic Effects of the Sunspot Cycle. Ralph E. DeLury, Dominion Observatory, Ottawa.

10. The Redward Displacement of Solar Limb Spectrum Lines. Ralph E. DeLury, Dominion Observatory, Ottawa.

11. A Corpuscular Theory of Light and the Redward Shift. Ralph E. DeLury, Dominion Observatory, Ottawa.

12. Distribution of Sun-spots in Longitude. Hazel M. Losh, University of Michigan Observatory, Ann Arbor, Mich.

13. Navigation Near the Pole. Heber D. Curtis, University of Michigan Observatory, Ann Arbor, Mich.

Wednesday Morning Session, Joint Session with Royal Astronomical Society of Canada, June 29, 10.00 a.m.; Dominion Observatory, Carling Avenue.

1. The Absolute Magnitudes of the P Cygni Stars. C. S. Beals, Dominion Astrophysical Observatory, Victoria.

2. A Study of Alpha Cygni in its Relation to P Cygni Stars. C. S. Beals and G. H. Blanchet, Dominion Astrophysical Observatory, Victoria.

3. The Present State of Our Knowledge of Variable Stars in Globular Clusters. Helen B. Sawyer, David Dunlap Observatory, Richmond Hill.

4. Spectrophotometry of the Surface Features of Mars. P. M. Millman, David Dunlap Observatory, Richmond Hill.

5. Observations of Line Intensities in Some Solar Type Stars. K. O. Wright, Dominion Astrophysical Observatory, Victoria.

6. Helium Lines and Electric Fields in Some B Type Stars. A. Vibert Douglas, McGill University, Montreal.

7. On the Use of Aluminum-on-Glass Gratings in the Victoria Stellar Spectrograph. C. S. Beals and Andrew McKellar, Dominion Astrophysical Observatory, Victoria.

8. The Aluminizing Apparatus of the Dominion Astrophysical Observatory. Andrew McKellar, Dominion Astrophysical Observatory, Victoria.

9. The Orbits of the Spectrographic Components of *Beta* Persei. J. A. Pearce, Dominion Astrophysical Observatory, Victoria.

10. Definite Orbital Elements of the Spectrographic Binary *Beta* Arietis. R. M. Petrie, Dominion Astrophysical Observatory, Victoria.

11. The Orbit of the Spectrographic Binary H.D. 195986. Andrew McKellar, Dominion Astrophysical Observatory, Victoria.

12. An Inductive Impulse Method for Instantaneous Operation of Relays. J. P. Henderson, Dominion Observatory, Ottawa.

13. A New Time Signal Clock. R. Meldrum Stewart, Dominion Observatory, Ottawa.

Thursday Morning, Joint Session with Royal Astronomical Society of Canada, June 30, 10.00 a.m.; Masonic Temple, 111 Metcalfe Street.

*Symposium*: Atmospheric Ozone and Measurement of Ultra-Violet in Solar Radiation.

1. Atmospheric Ozone as a Constituent of the Atmosphere. B. Haurwitz, Department of Transport, Canadian Meteorological Service, Toronto.

2. Ozonosphere Temperatures under Radiation Equilibrium. E. H. Gowan, University of Alberta, Edmonton.

3. Atmospheric Ozone as Related to Meteorology. Chaim Pekeris, Massachusetts Institute of Technology, Cambridge, Mass.

4. The Determination of Atmospheric Ozone from the Measurement of Ultra-Violet Solar Radiation. Brian O'Brien, University of Rochester, Rochester, N.Y.

David Dunlap Observatory,
Richmond Hill, Ontario.

# THE PROBLEM OF LUNAR CHANGES

By Walter H. Haas

DURING the summer of 1935 it was the author's privilege to study under the late Professor William H. Pickering, whose recent passing has been a real loss to science. It was at that time that the author became interested in Professor Pickering's observations of changes on the moon, and he has continued his lunar investigations at Mount Union College in Alliance, Ohio. Though much work still remains to be done, the author would here like to state the results of three years of observation and analysis.

Pickering has observed in a number of lunar regions periodical changes that repeat themselves every lunation. For example, dark areas develop and fade in Eratosthenes, a bright area around Linné varies in size, Messier and Pickering alter their sizes and shapes, and the peaks of Theophilus undergo changes of appearance. Pickering attributed these changes to physical agencies on the moon; i.e., to vegetation, to clouds, to snow, to frost, etc. His explanations demand the presence of a lunar atmosphere, a controversial point. Scientists have long been accustomed to regard the moon as completely dead and naturally received Pickering's observations and theories with much skepticism. That the changes do occur much as Pickering asserted has been established, but the explanation he gave is still not necessarily correct. The majority of astronomers now ascribe these changes to the variations in the angle at which sunlight is incident upon the lunar rocks. The moon's surface is granulated, a fact proved by the disproportionate increase in brightness of the moon toward the full phase; and it is thought that this granulation causes the area to vary in brightness or in intensity with the ever-changing angle of incident light and thus produces the changes observed. It is between these two theories, incident light and physical change, that the author has attempted to decide. To be sure, there may be some other possible explanations; e.g., a chemical change upon the surface of the rocks occurring under a low sun; and it is altogether possible that there is not one explanation for all the changes.

One may investigate these lunar changes in four different ways: drawings, observations of colour, estimates of intensity, and photography. For any lunar observation one should compute the sun's selenographic colongitude, usually called simply colongitude. This quantity is given in the *American Ephemeris and Nautical Almanac* for every day of the year. It tells us the position of the sun as seen from the moon and is approximately indicative of phase. New moon occurs near 270°, first quarter, near 0°; full moon, near 90°; and last quarter, near 180°. Drawings are the most inclusive and most used method of attack on this problem. Drawings should be distributed widely enough over the lunation to furnish a complete picture of the cycle of changes taking place. Lunar colours are usually very vague and can be observed only by the use of filters. What should be done is to assume that the *maria* are neutral gray under a high sun and to compare the region examined for colour to such *maria*. Intensities, or brightnesses, have to be estimated upon some scale; the standard one extends from zero (shadows) to ten (brightest areas). All lunar changes may be interpreted as changes in intensity. Plotting the intensity of a mark against the colongitude gives the intensity-curve, and such intensity-curves are of interest and importance. These first three methods of study all involve subjective errors, and photography is free from this difficulty. Photographs of value can usually be made only with telescopes of long focal lengths, and photographs are inferior to the best drawings. A skilled observer can see and draw distinctly details that are a confused blur on a photograph. The lunar changes being discussed in this paper can be photographed and have been photographed. Such photographs confirm the general cycle of changes seen visually.

The author has found that lunar changes can be divided into certain classes; the division he is using at present is given in the table below:

A. Dark areas
   1. Areas darkest more than two days from sunrise or sunset
   2. Areas darkest at sunrise
   3. Areas darkest at sunset

B. Bright spots
   1. Spots brightest more than two days from sunrise or sunset

2. Spots brightest at sunrise
3. Spots brightest at sunset

C. Colours

1. Colours seen more than two days from sunrise or sunset
2. Colours seen at sunrise
3. Colours seen at sunset
4. Colours or differences in darkness seen in shadows

Dark areas seen under a high sun are usually vague. The type A1 areas are less common than the A2 or A3 areas, for many areas dark under a high sun are darkest at sunrise or sunset. Floors of craters affected by A1 changes are often uniform in shade under a low sun. The intensity-minima of such areas show no prefreence for the noon colongitude. Types A2 and A3 areas manifest themselves as low-sun darkenings. They affect every kind of lunar formation, including those bright under a high sun. Such darkenings may be very transient and sometimes exhibit rapid changes. These A2 and A3 changes sometimes cause areas free of shadow to look as dark as shadow; and these false-shadows linger long in the morning and appear early in the afternoon. The western sides of craters, where shadow was last present, are often the darkest part of a crater in the forenoon; and the eastern sides, where shadow will first appear, are often the darkest in the afternoon.

Bright spots are not as a rule outstanding under a high sun. Type B1 changes include the host of vague bright spots seen only for a few days at lunar noon but also affect central peaks and the more conspicuous floor spots. The intensity-maxima of these two latter classes of marks are not always at noon. Some spots bright at noon are brightest at sunrise or sunset. Types B2 and B3 changes are almost restricted to walls of craters, type B2 to the east inner walls at sunrise and type B3 to the west inner walls at sunset. These spots are sometimes very brilliant, especially when the sun is just rising or just setting. Their changes in brightness are sometimes rather rapid. These B2 and B3 changes sometimes affect central mountain masses and outer walls.

Type C1 colours appear under a high sun and differ little from neutral gray. They alter but slowly from day to day. Such hues probably do not occur widely. Types C2 and C3 colours are seen

under a low sun. They are more conspicuous than the high-sun hues and are occasionally almost vivid. They occur more widely than C1 changes but not as widely as A and B changes. These hues usually fade out within two days after sunrise or appear less than two days before sunset. Type C4 changes are abnormalities in shadows. Professor Pickering observed a number of times that the sunrise shadow in Stevinus was redder than the one in the neighbouring crater Snellius. The colours are usually more difficult to observe than the differences in darkness. The author has repeatedly confirmed abnormalities in the sunrise shadows of Stevinus, Eudoxus, and Phocydides. There are doubtless other abnormal shadows than these three. Twilight affects of some sort might be the explanation; and indeed such an effect was observed directly in the crater Pickering on October 4, 1936, at 9 h., 15 m., G. C. T., colongitude=134°.

We should not fail to note the wide occurrence of these changes, except of type C changes; and no satisfactory explanation can ignore this prevalence of the varying regions. Scarcely any crater walls escape a low-sun brightening, and few crater walls and floors are unaffected by a low-sun darkening. Under a high sun we see bright spots and dark areas in craters scattered over the whole moon. These various phenomena exhibit themselves with different strength in different craters, but they do occur to some extent in almost all. Professor Pickering thought that the changes were absent in the polar regions of the moon; the author has not yet investigated this aspect of the lunar problem but doubts the actuality of such a condition.

We might note briefly the contrast between changes of type 1 (high-sun) and types 2 (sunrise) and 3 (sunset). The high-sun changes are slow; the low-sun ones are fairly rapid. The high-sun detail is usually inconspicuous; the low-sun detail is sometimes striking. Some lunar regions are affected by variations of each kind.

Professor Pickering repeatedly suspected that the appearance of some lunar marks varied at the same colongitude in different lunations. This possible state of affairs is important, for it cannot be explained by the incident light theory and favours highly the physical change hypothesis. To be sure, we should make a reservation here; the altitude of the sun above the lunar horizon at any point varies by about three degrees in the course of the earth's year, but such a

variation is small. Libration would have some influence upon craters near the limb of the moon. So many variable factors affect the appearance of a lunar region that the investigation of irregular changes of this sort is difficult. Pickering very strongly suspected changes of this sort but was not absolutely certain; he thought that a larger telescope, perhaps a twenty inch refractor, would solve the question decisively in the splendid seeing of Jamaica. Rayleigh has likewise asserted that changes on Pico occur irregularly. The author has observed the same phenomenon in a number of lunar regions during 1936 and 1937. Colours, intensities, and general appearances are all subject to this irregular variation. The results of the different observers agree that developments may take place earlier in some lunations than in others.

If, however, lunar changes can be explained by the incident light theory, we may use the intensity-curves previously mentioned to investigate the structure of the surface of the moon. By assuming sizes for the granulated particles of the moon's surface, we ought to be able to compute mathematically theoretical intensity-curves for lunar marks. We could in practice reverse the process and use the observed curve to determine the size of the particles. Experiments in the laboratory upon the reflection of light from the surfaces of rocks similar to these existent on the moon might be very informative. R. W. Wood in 1912 found, by photographing the moon in light of different wave-lengths, that a region near Aristarchus behaved as did sulphur-coated rocks and concluded that sulphur was here present on the moon. Investigations of this sort might tell us much about our satellite's surface.

A lunar eclipse to some extent is a test between the theories of incident light and physical change. If the incident light theory is correct, a lunar eclipse should have no effect at all on detail; but if physical changes are involved, the withdrawal of sunlight while the earth's shadow passes ought to produce observable results. Pickering indeed observed that the bright area around Linné increased in size during some eclipses and attributed this effect to a deposition of hoarfrost consequent upon the fall of temperature during the eclipse. The Linné area's increase in size has not been observed by all, and it is probably absent during some eclipses. Pickering also observed

that the colour of Grimaldi and the dark areas of Eratosthenes were affected by eclipses but that most areas he suspected of physical change looked the same after an eclipse as before. The author observed the eclipse of July 16, 1935, in the hope of detecting some effects of this sort. Most of the regions chosen for observation were unaffected, but part of the Ricciolli dark area may have faded during the shadow's passage. Evidence about the last point is inconclusive. It would certainl be worth while to check these possible effects of eclipses upon detail in the future.

We might note that lunar changes are sometimes very rapid; this statement applies only to low-sun changes and especially to low-sun darkenings. Marks bright under a high sun will be darkened at sunrise or sunset and will often lose or gain this darkness rapidly. Changes can at times almost be seen occurring as one observes, and a space of an hour can produce distinct differences in appearance. A good example is the floor of Ricciolli at sunrise, colongitudes 75° to 77°.

The author would like in conclusion to speak of the possibility of valuable work in this field of lunar changes with small telescopes. The moon has been too much neglected in recent years. This is one phase of astronomy in which amateurs can do work of real value. Indeed, the poor seeing almost always present in much of United States renders a large telescope very little superior to a small one, if indeed it is not inferior to a small one, in the perception of lunar detail. It is true that poor seeing is a handicap in the study of such detail, but other factors than the seeing are of influence in perceiving detail. The physiology and training of the eye are of significance. An organized group of careful and persistent amateurs could do much of value on the moon; for the number of regions to be examined for change is very large, and it is always of advantage to have several observers at work on a problem rather than one.

The author concludes this paper in the hope that future observation and analysis of the sort herein discussed may help solve the mysteries of the moon's rugged surface.

Mount Union College.
March 12, 1938.

COMMUNICATIONS
FROM THE
DAVID DUNLAP OBSERVATORY
Number 2

# THE SPECTRUM OF GAMMA CASSIOPEIAE

By J. F. Heard

The spectrum of the bright-line star, $\gamma$ Cassiopeiae, continues to exhibit marked variations of unique character. In this Journal, vol. 31, p. 60, 1937, the writer traced qualitatively the variations throughout 1936. In the present communication further variations up until August, 1938, are traced and measurements of the displacements of the emission lines due to several elements are given.

## Description of the Variations

During 1936 the principal variations consisted of (a) the replacement of helium absorption lines by emission, (b) a gradual decrease of the doublet separation of all emission lines, and (c) an increase of the intensity of the violet components over the red for the hydrogen and ionized iron emission doublets.

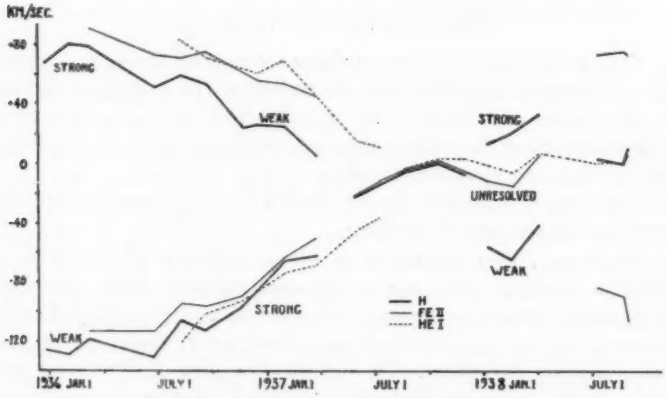
The further variations in the character of the spectrum are now described under several headings.

*Hydrogen*: The separation of the components of the hydrogen emission doublets continued to decrease early in 1937, the violet components remaining stronger than the red. From May 29 until the end of the year the hydrogen lines were single, or at least unresolved on our plates. During the first part of 1938 they were again double with the intensities reversed, that is, the red components stronger than the violet. On July 5 and until August 26 they were again not resolved into doublets, although they were wider than during the single phase in 1937. During 1938 broad absorption lines of hydrogen overlying the emission lines have been a feature not previously prominent during recent years.

*Ionized iron*: The emission doublets of ionized iron varied in a manner similar to those of hydrogen during 1937 except that up

until the single stage was reached they had slightly larger separations and were displaced to the red as regards the hydrogen lines. In 1938 they were unresolved on our plates until July 5 when the strongest line was barely resolved. Plates taken in August show them more clearly resolved into components of approximately equal intensity with increasing separations.

*Helium*: In 1937 the emission doublets of helium remained resolved with decreasing separations (though always larger than those of the hydrogen and ionized iron doublets) and with approximately equal intensities of red and violet components until May 29; plates of July 9 and later show the helium lines unresolved into doublets. Some 1938 plates indicate resolution of the helium lines into narrow doublets again. The helium emission is less intense in 1938 than in 1937.




Emission line velocities for $\gamma$ Cassiopeiae.

*Other emission lines*: Emission lines due to ionized calcium, magnesium, silicon, nickel, cromium and scandium were measured These showed structure and variations similar to, but not identical with, those of the ionized iron lines.

*Absorption lines*: During most of 1937 no absorption lines at all were to be seen in the spectrum. Early in 1938, however, diffuse

VELOCITIES FROM EMISSION LINES FOR $\gamma$ CASSIOPEIAE

| Date | H Emission | | | Fe II Emission | | | He I Emission | | |
|---|---|---|---|---|---|---|---|---|---|
| | Double | | Single | Double | | Single | Double | | Single |
| 1935—Dec. 25 | −125.9 | +67.4 (2) | | | | | | | |
| 1936—Feb. 2 | −128.8 | +79.7 (2) | | | | | | | |
| Mar. 7 | −118.1 | +78.5 (2) | | −113.0 | +91.2 (4) | | | | |
| June 25 | −131.5 | +50.2 (4) | | −112.3 | +72.5 (6) | | | | |
| Aug. 8 | −105.7 | +59.7 (4) | | −94.6 | +70.5 (5) | | −121.0 | +83.5 (1) | |
| Sept. 19 | −112.1 | +53.2 (4) | | −96.5 | +75.1 (4) | | −101.1 | +71.7 (1) | |
| Nov. 19 | −97.5 | +24.3 (5) | | −89.8 | +60.3 (8) | | −92.9 | +62.9 (5) | |
| Dec. 22 | −84.4 | +25.9 (3) | | −79.8 | +54.8 (6) | | −83.3 | +60.6 (2) | |
| 1937—Jan. 29 | −65.5 | +25.1 (3) | | −63.2 | +53.2 (7) | | −72.5 | +69.1 (3) | |
| Mar. 24 | −61.5 | +5.8 (2) | | −49.9 | +44.5 (6) | | −67.6 | +44.6 (3) | |
| May 29 | | | −22.8 (4) | | | −22.4 (18) | −44.2 | +15.0 (2) | −18.2 (3) |
| July 9 | | | −14.0 (6) | | | −11.4 (9) | −35.3 | +10.8 (1) | −9.4 (8) |
| Aug. 19 | | | −5.7 (6) | | | −5.0 (22) | | | −5.8 (7) |
| Oct. 14 | | | −0.8 (6) | | | +2.9 (9) | | | +1.1 (7) |
| Nov. 26 | | | −6.4 (4) | | | −6.3 (2) | | | +3.6 (2) |
| 1938—Jan. 5 | −56.2 | +13.3 (2) | −10.6 (2) | | | −7.0 (7) | | | −1.9 (3) |
| Feb. 15 | −65.4 | +20.0 (2) | −8.8 (2) | | | −14.6 (7) | −39.6 | +28.7 (3) | −7.8 (1) |
| Apr. 1 | −41.3 | +32.2 (1) | +3.4 (3) | | | +5.2 (3) | | | +6.8 (2) |
| July 5 | | | +3.3 (4) | −83.3 | +72.8 (1) | −2.7 (4) | | | +0.7 (4) |
| Aug. 19 | | | −0.1 (4) | −88.9 | +75.7 (10) | | −84.7 | +68.4 (1) | +0.5 (2) |
| Aug. 26 | | | +10.1 (4) | −105.0 | +73.5 (9) | | −86.9 | +66.8 (2) | +6.1 (1) |

absorption lines due to ionized oxygen and doubly ionized silicon were prominent. In July and August these had weakened appreciably.

## Radial Velocity Measures

The accompanying table gives the velocities yielded by emission lines, double and single, of hydrogen, ionized iron and helium from twenty-one spectrograms in the interval from December 25, 1935 to August 26, 1938. The spectrograms were taken on Eastman Process emulsion with the David Dunlap Observatory one-prism spectrograph fitted with the 25-inch camera lens which gives a dispersion of about 33 A/mm. at $H\gamma$. On some of the spectrograms where the doublet separation is small some lines are resolved into doublets and others are not. In these cases entries are found in both the single and double columns. The figures in parentheses are the numbers of lines from which the velocities were computed.

The velocities of the table are incorporated into the accompanying graph with the points joined by straight lines to show the general trend of the displacements. This graph is necessarily somewhat arbitrary for those times when the separation was so small as to make the question of resolution uncertain.

Richmond Hill, Ontario.
September 6, 1938.

# METEOR NEWS

**Observations relating to meteors and meteorites are cordially invited.**

## Meteor Spectra—List V

Following the practice of other years, a list of the meteor spectra photographed in 1937 is given below. The spectra are numbered consecutively for convenience and every attempt is made to keep the records complete. The writer would greatly appreciate learning of any errors or omissions in these lists of meteor spectra.

*Photographic Meteor Spectra—List V*

| *Spectrum* | *Date* | *Place* | *Identification* |
|---|---|---|---|
| XLIII | 1937, Aug. 4 | Kutschino Obs., U.S.S.R. | |
| XLIV | " Aug. 13 | Richmond Hill, Ont. | Perseid |
| XLV | " Dec. 13 | Richmond Hill, Ont. | Geminid |

Dr. Astapowitsch writes that Spectrum XLIII was obtained by chance while photographing the spectrum of Finsler's Comet. It consists of five bright lines which are of the iron spectrum, and seems to show no trace of the H and K lines of ionized calcium which are such a common feature of the majority of meteor spectra. It is therefore Type Z. Dr. Astapowitsch also writes that 560 plates were exposed on the Simeize meteor expedition of Aug.-Sept., 1937, and 15 direct meteor photographs were obtained. There is a possibility that some faint meteor spectra were also secured but no definite information has been received concerning this point.

Both Spectrum XLIV and Spectrum XLV, photographed at the Dunlap Observatory, were taken by a spectrograph equipped with a rotating shutter which covered the lens several times each second. They are believed to be the first photographed in this way. Unfortunately, neither spectrum can be analysed as completely as desired since in the first case the meteor crossed the plate nearly in line with the dispersion, thus masking fine details of the spectrum, while the second spectrum is very faint. Both show the lines of ionized calcium as well as the iron lines, and are Type Y.

## The Fireball of Aug. 14, 1938

On the whole the summer meteor observations were rather dis-

appointing both from the standpoint of the weather and the number of meteors seen. At most of the Ontario stations clouds were encountered on two or three of the Perseid nights and these, together with the full moon, made the observing conditions about as adverse as possible. On top of this, from a preliminary analysis, it would seem that Perseid meteors were really scarce this year, with a marked absence of many bright objects. Valuable reports have been received from a number of stations, however, and these were all the more welcome because of the difficulty of securing observations this year. Increased interest was shown in photography and even in cases where there were no positive results the experience gained will be valuable in view of future programmes when it is hoped the weather man will be kinder. The Perseid observations as a whole will be discussed in a future number of the JOURNAL. It might be a good place here to remind observers that next year, 1939, the new moon falls almost exactly at the Perseid maximum and conditions should be excellent for both visual and photographic work.

Only one really bright meteor was reported. This appeared at 9.40 p.m. E.S.T., Sunday evening, Aug. 14. It probably reached a maximum luminosity in the neighbourhood of magnitude –5 and was noteworthy for its extremely long path and slow speed. It appeared to the west of Toronto travelling south and was not a Perseid. A number of good observations of this object have been received and the writer would like to obtain all information possible from anyone who saw it.

P. M. M.

# REVIEW OF PUBLICATIONS

*La Notion de Temps. Temps Physique et Relativité. La Dynamique du Point Matériel,* par Ernest Esclangon, 76 pages, 6½ x 10 ins., Paris, Gauthier-Villars, 1938.

This memoir falls rather naturally into four divisions. The first consists of a fairly detailed discussion of the notion of time; the second discusses the time phenomenon in restricted relativity; the third develops some particle dyamics theory from the relativity standpoint; and in the fourth there is given a resumé of results together with some suggestions of a speculative character.

On the whole the paper has many good features. The first part is especially well done. The pre-relativity conceptions of time, as an absolute objective reality, and the post-relativity realizations of its subjective character are brought into vivid relief.

There is a careful analysis of the Michelson experiment given to show the extent, and the limitations, of the conclulsions that can be drawn from it. Then the Lorentz transformations are obtained, by what the author calls the principle of reciprocity, in a very direct and simple manner. As a matter of fact he obtains a transformation which has a broader interpretation and which will give the Lorentz transformation as a special case.

The author distinguishes between hypothetical time, physical time and astronomical time. All time measurements consist essentially in the counting of some recurring phenomenon, and among such phenomena for physical time he cites: to and fro motion of light over a path of given length, chemical reactions, biological reactions, et cetera. The distinction between a physical clock and a hypothetical clock is not too clear, but apparently a hypothetical clock system is regarded as an adopted standard with which to compare other phenomena. On pages 34-36 there is given an argument to show that all phenomena, for any given observer, are affected in the same way as far as time retardation is concerned. It seems to the reviewer, however, that the validity of this theory is in no way strengthened by the argument given. The fact that S and S′ appear the same to S″, and that S and S″ appear the same to S‴, does not require that

S, S′ and S″ are affected alike. It is not legitimate to superimpose in this way the appearances to two observers who are moving relative to each other.

An important distinction between physical time and astronomical time is made. The latter, determined by recurring revolutions of a rotating body, it is claimed is invalid as a natural measure of time in the relativity sense. But it is not claimed that there is any disparity between physical and astronomical clocks. The distinction appears to be one of hypothetical control.

In the third division of the paper the dynamics of a particle is discussed by a further use of the principle of reciprocity, and also by the principle of invariance. But near the beginning of this discussion there is a paragraph which is difficult to understand. On page 43 there occurs the following:

"Supposons que, dans le système S, la vitesse initiale soit égale à $u$. Le mouvement est determiné; par conséquent, l'accélération du/dt sera déterminée par une seule fonction de $u$, car il est clair que le mouvement est indépendant de la position initiale du mobile. On peut donc écrire (60)

$$\frac{du}{dt} = \phi\,(u)\ ''$$

The $u$ is thus *defined* as the initial velocity but is *used* as the velocity at any point, and anyway it is by no means clear why, in the case under discussion, the acceleration should be a function of the velocity alone.

Moreover, this equation (60) plays a fundamental role in the development which follows, so the validity of much subsequent discussion depends upon this equation.

On page 57 expressions are given for *longitudinal mass* and *transverse* (*lateral*) *mass*. The former agrees with that commonly given for this term but the latter differs in the exponent from that hitherto given, and the author calls attention to this difference.

In the latter part of the discussion of dynamics the retardation of time is considered for the case of a particle moving in a closed path, and in particular of a planet moving about the sun. This is done by applying the formulae of restricted relativity alone. This gives the

retardation due to motion, but it should be pointed out that this is only a part of the retardation in such cases. The very *presence* of ponderable matter such as the sun produces a gravitational potential field and this potential has a retarding influence, as is shown by the general theory of relativity.

The extension of the time retardation theory from uniform motion to non-uniform motion is made by a sort of integration argument, and the author gives two examples to illustrate the time retardation factor. But as applied to non-uniform motion the retardation is given from the point of view of the same observer in each case. The problem of accounting for this time distortion from the point of view of the other observer, *viz.*, the observer who moves in a closed orbit, has been solved by the reviewer,* but the solution depends upon retardation as caused by gravitational potential.

In the concluding division an interesting summary to co-ordinate the previous developments is given, and there are added some related speculations. These latter might from one standpoint be regarded as far-fetched, but inasmuch as they offer an alternative to the theory of the expanding universe they are at least worthy of consideration.

J. W. Campbell

*Philosophical Magazine, Series 7, Vol. XV, p. 48, January, 1933.

# NOTES AND QUERIES

**Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.**

## Error in 1938 Handbook

In the Astronomical Phenomena for November (page 51), an error has been called to the attention of the Editor. On November 8 when Uranus is in opposition to the sun, the distance should be 1,735,000,000 miles. The distance of Mars on that date was accidentally given in the Handbook instead of that of Uranus.

## A New Publication

The first number of "Occasional Notes", a new periodical published by the Royal Astronomical Society of London, has been received. The President of the Society, Dr. H. Spencer Jones, Astronomer Royal, explains in a foreword the purpose of the Notes as follows:

The papers published in the Monthly Notices contain original contributions to astronomy, or the results of observations and their discussion. Many of these papers are necessarily of a mathematical or technical nature. Though by their publication the Society is making an important contribution towards the advancement of astronomical science, it is inevitable that many of the papers published are of interest mainly to a limited number of investigators.

The Council realises that many of the Fellows, who, by their support of the Society, are helping the advancement of astronomy, find most of the papers published in the Monthly Notices too specialised to read with profit. The Council has therefore decided to publish at intervals circulars (to be called "Occasional Notes") containing material that it is hoped will prove of interest to the general body of Fellows. It is intended that these Occasional Notes shall contain short articles, partly of a topical and partly of a general character, which though scientifically accurate will be written in non-technical style. They may contain also reports of talks or addresses given at meetings of the Society and general information about the activities of the Society.

It is hoped to issue the Occasional Notes at the rate of three or four a year, in the first instance. They will be paged consecutively so that they can ultimately be indexed for purposes of reference, and bound.

In this, the first of these Occasional Notes, is given (by H. Spencer Jones) an account of the interesting asteroid, Hermes, which recently made an unusually close approach to the Earth; and an account of a talk on quartz crystal clocks recently given before the Society by Mr. Essen of the National Physical Laboratory.

The two articles of this first number are written in a most

interesting and careful manner. The Fellows of the Society are to be congratulated on having made available to them this new series of papers, which should so well supplement the invaluable Monthly Notices.

### Astronomical Instrument Manufacturers

We have been informed that the engineering firm of Sir Howard Grubb, Parsons and Company, of Newcastle-on-Tyne, England, has taken over the firm of Cooke, Troughton and Simms, Ltd., instrument makers of York and London, England. This unites two of the historic astronomical instrument manufacturers of England.

The firm of Cooke, Troughton and Simms itself was formed by the merging of three old firms. The first, Troughton, a century and a half old, and Simms, were engaged primarily in instruments for position work, such as large theodolites and transit instruments. The firm of Thomas Cooke, founded in 1836, is noted for its "Cooke" photographic lens, astro-photographic cameras, and the University of Cambridge 25-inch refractor, constructed in 1870, and at that time the world's largest telescope. The firm has since built large numbers of telescopes, domes, and accessories of various sizes. As well as large observatory equipment, they have specialized in the construction of smaller refractors, primarily for amateur use.

The firm of Grubb-Parsons was founded over a century ago by Thomas Grubb, who manufactured astronomical instruments, machine tools, etc. His first large telescope was the 15-inch reflector for the Armagh Observatory, in 1835. Later he built a 48-inch reflector for Melbourne Observatory. He was succeeded by his son, Sir Howard Grubb. The firm was acquired in 1925 by the late Sir Charles Parsons of the marine turbine fame, the son of the Earl of Rosse, who built the six-foot reflector at Birr Castle, Ireland. Since then, Grubb-Parsons has built large telescopes, including the 36-inch reflector of the Edinburgh Observatory and the 74-inch reflector of the David Dunlap Observatory, and has about completed a similar 74-inch for Radcliffe Observatory, South Africa. The firm will now be equipped to design and manufacture a complete range of astronomical instruments.

### Two New Satellites of Jupiter

Dr. Seth B. Nicholson, of the Mount Wilson Observatory, has discovered two new satellites of the planet Jupiter. (Harvard Announcement Cards 455, August 31, and 456, September 2.) Jupiter X is recorded on photographs made with the 100-inch reflector from July 6 to August 25, and Jupiter XI has been followed from July 30 to August 25. Both these objects are very faint, being of about the nineteenth magnitude. On August 25 their positions were approximately as follows:

| | | |
|---|---|---|
| Jupiter X | $-4.^{m}6$ | $+6'$ |
| Jupiter XI | $+6.^{m}1$ | $+11'$ |

Orbital elements have not yet been published for these satellites. It will be recalled that Dr. Nicholson was also the discoverer of Jupiter IX, another nineteenth magnitude satellite, in 1914 at the Lick Observatory. From its brightness Jupiter IX was inferred to have a diameter of about 25 miles; these two new satellites probably have a similar diameter.

F. S. H.

### Sunrise at the Summer Solstice

The following remarks are from a letter written by an amateur-astronomer-philosopher and received too late for the July-August issue:

To-day being the longest day of the year, I have time to write. . . . I think to-day would make a good statutory holiday, instead of the King's bogus birthday, and I need something to distinguish my days now-a-days. I saw the dawn, and spent an hour watching the event from my bedroom window. How the light feels its way through our dense oak trees. It is no ordinary sunrise seen through a forest, and the light, if you can call it that, reminded me of that dismal total eclipse of the sun which came to Toronto in January, 1925. However, it is worth while getting up to see a sunrise occasionally, and this is a red-letter day to choose. I felt sorry for a poor robin hopping over our front lawn while it was still dark, looking for the early worm, and thinking of the long day ahead of it. It was a one-legged robin I have seen many times around the house, and he supports himself with his tail. A few evenings ago I turned the hose on him without realizing it was my one-legged friend, and the poor thing couldn't get out of the way very well. Think of my distress at this exhibition of my real character. And I have always thought Napoleon was a callous brute. Another thing I saw was the moon, hardly a crescent as it was very near third quarter, with its

cusps turned in the right direction, away from the sun! That reminds me of the lady friend who telephoned me to ask if I knew anything about the cusps of Venus. I was flattered at being asked an astronomical question, and tried to explain, but she cut me off by saying she only wanted to know as she was working out a cross word puzzle.

But to return to the dawn of the "longest day in the year". I think these simple easily-observed things in nature give me a greater thrill than what I saw through the telescope; which so often gives a hazy image. The experiment I try in understanding "sunrise" or "sunset", is to imagine what is really happening. That is, I insist to my mind that the sun is "fixed" as a star. At sunset I face the sun and imagine the earth turning to the east, with me as an upright figure going backwards to the east, and remaining in that position all night; upside down as it were, until I am brought up by the turning earth and find myself at dawn with my back to the sun, which has never moved. Then I turn my head "at the sound of the bird" and, looking across the earth's surface I see "the glorious sun uprist". From my bedroom window this morning I watched from darkness until the shafts of light from the sun reached the tree tops. It is the "dawn", the miracle of returning light, that gives me the thrill; creation, the new day. There was the faint stir of the "wind before the dawn", which made me wonder if it were true that this always happens; but my knowledge doesn't cover that. The air is so seldom really still that we may imagine such things.

C. A. C.

# MEETINGS OF THE SOCIETY

## AT MONTREAL

*November 5, 1937.*—Annual meeting in Macdonald Physics Laboratory, at 8.30 p.m. Mr. H. F. Hall was in the chair.

The reports of the Secretary and the Treasurer were read and adopted, and the thanks of the Society tendered to the auditor, Mr. O. A. Ferrier. The report of the Librarian was read and adopted. The election of officers then took place.

New members elected: Miss Muriel Wilson, H. Abramovitch, C. S. Westover.

The report on Summer Observations was made by Mr. F. DeKinder.

Dr. A. V. Douglas projected views of Finsler's Comet from several astronomical journals and with a series of slides of great comets of the past, reviewed the subject of "Comets"—their orbits, periodicity, spectra and composition and the behaviour of their tails under the influence of pressure of light.

*December 14, 1937.*—A regular meeting was held in the Macdonald Physics Laboratory.

The speaker was Mr. R. Meldrum Stewart, Director of the Dominion Observatory, Ottawa, and his subject was: "International Cooperation in Astronomical Investigations."

Reference was made to the International Astronomical Union and the various programmes of research undertaken by the observatories of different countries. Special reference was made to the latitude and longitude measurements and the Wegener Theory of Drifting Continents was carefully explained and illustrated by excellent slides. The time difference between Ottawa and Greenwich was determined as $5^h\ 2^m\ 51^s.940$ in 1892 and in 1926 as $5^h\ 2^m\ 51^s.948$ which might suggest an 8-foot drift westward in 45 years, if it were not that the early observations, before the wireless methods were employed, were subject to large errors. No series of recent precise measurements of longitude give any definite proof of continental drift.

*February 3, 1938.*—A regular meeting was held at 8.30 p.m.

Five reels of motion picture film from the Educator Film Co., New York (Ruroy Sibley) entitled "Seeing the Universe," were shown: (1) The Sun—sun-spots, prominences, eclipses; (2) The Moon—excellent lunar craters, etc.; (3) The Planets—Venus, Mars, Jupiter; (4) Outer Planets and Comets; (5) Milky Way and Spiral Galaxies.

A crowded hall showed the interest in this form of meeting.

The President read a descriptive pamphlet during the progress of the film which greatly added to the educational value.

Comments of appreciation were made by Mr. A. Brownrig, Mr. G. R. Lighthall and other members and after some discussion and questions, the meeting adjourned.

*March 3, 1938.*—The regular meeting was held at 8.30 p.m.

The lecturer was Dr. J. F. Heard of the David Dunlap Observatory and his subject was: "Observations and Research Problems at the David Dunlap Observatory."

The equipment and operation of the 74-inch telescope and problems of silvering the mirror were first outlined. The 500-star radial velocity programme was described and the specific problems were referred to that different members of the staff work upon from time to time:—globular clusters and variable stars; meteors, selective absorption from particular areas on Mars; novae, especially the recent outburst showing evidence of five shells of expanding gas; the intensely challenging problem of the changing H and He lines in Cassiopaeia leading to the suggestion of a luminous rotating and pulsating ring of hydrogen with a further effect of reversal of red and violet intensities very difficult to explain unless the star turned over—an hypothesis requiring very unlikely special causes.

A. V. Douglas, *Secretary.*

## AT VICTORIA

*March 9, 1938.*—A regular meeting was held in the Y.W.C.A. parlours, at 8.10 p.m. with the president, Mr. Gordon Shaw, in the chair.

The president repeated the announcement that the prize of $5.00 is to be given to the Junior Member completing the best telescopic mirror during the year. All members were urged to make use of the library of the Society. Mr. Brydon stated that any approved Junior Member, not only those entering the contest, was welcome to a copy of his recent article on telescope mounting.

Dr. Petrie reported briefly on his recent trip to the Vancouver Centre of the Royal Astronomical Society and brought greetings from that branch.

Mr. Robert Wallace was then called upon to give the lecture of the evening, entitled "The Philosophy of an Exact Science". The whole lecture was an attempt to answer the question, "What is the nature of mathematics today?" The speaker stated that there are three main schools of thought: the logistic, the formalist, and the intuitionist, each with its own doctrines and leaders. Several modern descriptions of mathematics were given; the chief project of mathematicians during the last century, said Mr. Wallace, has been to organize their science and kindred sciences into a postulational form. The speaker outlined briefly the practical value of mathematics and pointed out that in many instances mathematics previously worked as a purely mathematical endeavour had proven of inestimable value to science.

The thanks of the meeting were tendered to Mr. Wallace for the valuable philosophy contained in his lecture and also for his excellent presentation of it.

*March 30, 1938.*—The meeting was held in the Y.W.C.A. parlours at 8.15 p.m. with the vice-president, Mr. Robert Peters, in the chair. Mr. Peters mentioned briefly several of the objects to be seen in the sky this month and gave also some interesting facts about James Bradley, born March 1693,

who discovered the aberration of light and who worked out an absolute proof of the motion of the earth in its orbit.

Mr. Ronald Hopkins then took over the meeting, giving an excellent explanation and demonstration of different stroboscopic effects. Mr. Hopkins stated that the stroboscope is primarily an instrument in which rapidly varying motion can be studied. The main use of this instrument is the study and balancing out of vibrations, the stroboscope proper being applied usually to reciprocating motion. Other uses are found in the study of motion in modern sewing machines, the study of ignition and combustion in gasoline engines; it is also applied in the construction of airplanes and in high-speed photography. The electro-balance, a type of stroboscope, is an instrument used in the study of turbines and generating armatures. Mr. Hopkins demonstrated several uses of the stroboscope and then illustrated many of the wonderful effects that can be obtained from various rapidly rotating designs.

A motion of thanks was tendered to Messrs. R. and L. Hopkins for the excellent discussion and demonstrations.

*April 20, 1938.*—The regular meeting was held in the Y.W.C.A. parlours with the president, Mr. Gordon Shaw, in the chair.

Mrs. Diana Watts was elected to membership in the Society.

The vice-president, Mr. R. Peters, gave a brief summary of current phenomena in the sky and directed particular attention to the sun-spots now visible.

Dr. John Stevenson, Associate Mining Engineer of British Columbia, gave the lecture of the evening. He had chosen as his topic "The Microscopic Study of Ores", and introduced the main discussion with a short explanation of what constitutes an ore, of the genesis or history of ores and of the five important classifications of ores. The microscope plays an important part in economic geology, in two ways. First, it is used in deciphering the history of an ore deposit. All information gained in this way is used in formulating accurate theories regarding local ore deposition. Second, the microscope has an important value in its application to metallurgical treatment of ore. Certain characteristics can be determined correctly only by use of this instrument. Next, investigation technique was discussed briefly. Dr. Stevenson explained how the specimen must be first polished and prepared for microscopic study so that finally the constituent minerals can be determined through the different diagnostic features. Excellent slides were shown to illustrate various points discussed.

A hearty vote of thanks was extended to the speaker.

PHOEBE RIDDLE, *Recording Secretary.*

# The Royal Astronomical Society of Canada

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